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IS 14269 (1995): Automotive vehicles - Integral power steering gear - Method of test [TED 2: Automotive Primemovers]

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स्वचल वाहन — समग्र पावर स्टीयरिंग गियर — परीक्षण पद्धति

Indian Standard

AUTOMOTIVE VEHICLES — INTEGRAL POWER STEERING GEAR — METHOD OF TEST

UDC 629·113·014·5 : 620·1

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August **1995**

Price Group 3

Automotive Suspension and Steering Systems Sectional Committee, TED 5

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Suspension and Steering Systems Sectional Committee had been approved by Transport Engineering Division Council.

When the gross vehicular weight increases, correspondingly the steering effort of the vehicle also increase and make maneuverability of the vehicle difficult. The integral power steering gear helps in the reduction of the driver's fatigue and thereby increases the safety. Now a days more and more vehicles are coming on the roads with power steering and the committee felt that there is an urgent need to specify the method of test to evaluate the performance of the steering gear.

The power steering enables the driver to circumvent any obstacle in a critical situation and thereby reduces the risk of accidents due to tyre puncture and subsequent dragging/studding. The method of test for mechanical steering gear is covered separately in IS 13476 : 1992.

The committee responsible for the preparation of this standard is given in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

AUTOMOTIVE VEHICLES — INTEGRAL POWER STEERING GEAR — METHOD OF TEST

1 SCOPE

1.1 This standard specifies methods to determine/evaluate the performance of power steering gears in respect of functional reliability and operational safety under static and dynamic conditions.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
11948 : 1986	Method of evaluation of steering effort of automotive vehicles
13476 : 1992	Automotive vehicles — Mechanical steering gear — Methods of test

3 GENERAL REQUIREMENTS

3.1 The dimensions and physical requirements of the test samples shall be as agreed between the manufacturer and the purchaser.

3.2 Test Media and Conditions

3.2.1 *For Low Pressure External Leak Test by Immersion*

Test gas — Dry gas (Nitrogen or air) at test pressures of 0·3 to 0·7 kg/cm^2 and at 7 to 10 kg/cm^2 shall be used

Immersion fluid — Water with appropriate rust preventive

3.2.2 *For Hydraulic Test*

a) Hydraulic fluid — ATF (Automatic transmission fluid — Type 'A' or 'F'). Unless otherwise agreed to between manufacturer and purchaser the fluid supplied shall be at rated pressure recommended by the manufacturer

b) Filtration — Full flow filtration of 25 micron (*Max*)

c) Hydraulic fluid temperature — 55 to 65°C

d) Test flow rate to the gear — This shall be as per manufacturer's recommendation

3.2.3 *Input Torque*

Input torque for internal leakage and unloading valve test shall be sufficient to close the control valve fully and shall be specified by the manufacturer.

3.2.4 *Power Steering Gear Mounting*

Unless otherwise specified, the test sample shall be mounted in such a manner that it keeps the input shaft horizontal and above the output shaft.

3.2.5 *Drop Arm/Pitman Arm*

Unless otherwise specified, the test sample shall be mounted in such a manner that it keeps the input shaft horizontal and above the output shaft.

4 TESTS

4.1 The following tests shall be carried out to determine/evaluate the performance of power steering gears. In general these tests shall be carried out on fresh samples in the order mentioned below, except where noted otherwise.

NOTE — The tests, loads, cycles specified in the standard are generally applicable. In particular cases, it may be often necessary to take into account the specific requirements of the vehicle operating conditions, environment so that the tests, loads, test cycles may be modified suitably by agreement between the manufacturer and the purchaser.

4.1.1 *Classification of Tests*

a) Type tests, and
b) Routine tests.

4.2 Type Test

The following shall comprise of type tests:

a) Functional/kinematic tests,
b) Static strength test, and
c) Dynamic tests/endurance tests.

4.3 Routine Tests

Functional/kinematic test

5 TEST PROCEDURE

5.1 Functional/Kinematic Tests

The following tests shall be carried out on a test bench (*see* Fig. 1) and the observations/values shall be recorded after each test. The

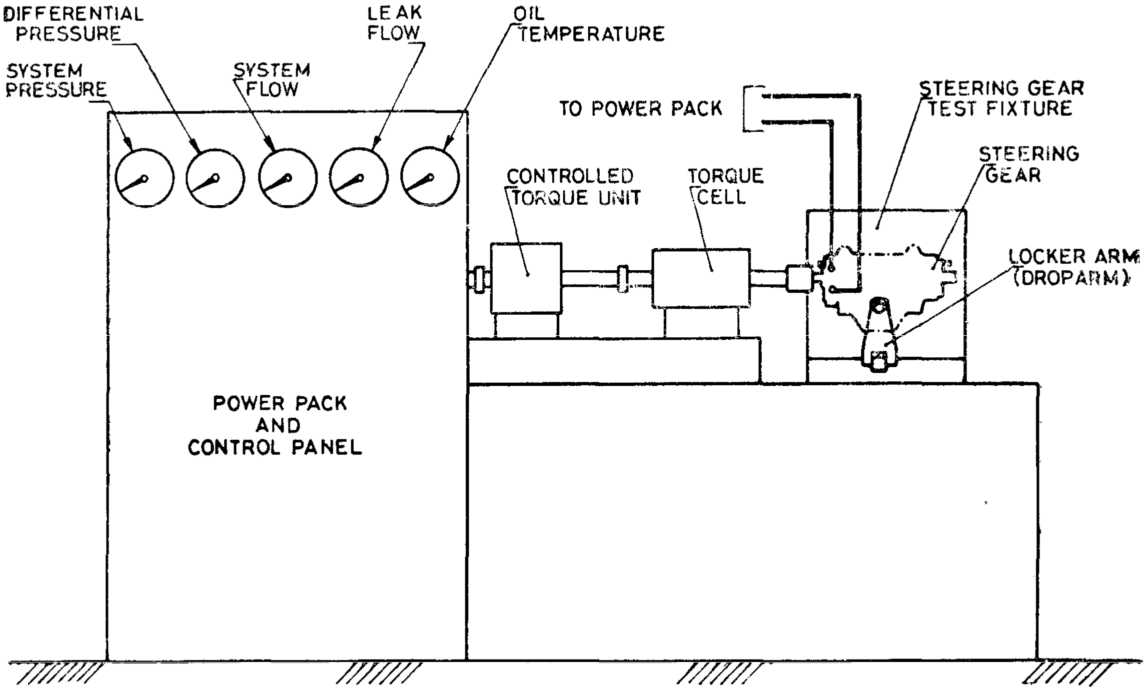

FIG. 1 TYPICAL FUNCTIONAL/KINEMATIC TEST BENCH FOR POWER STEERING GEAR

requirements of these tests shall be as agreed between the manufacturer and the user.

5.1.1 Number of input turns shall be recorded from centre to right/left extremes.

5.1.2 Friction torque shall be recorded at the centre and at the extremes without any assistance of power.

5.1.3 Input torque versus hydraulic pressure (across the gear) developed shall be carried out with hydraulic supply at rated pressure and test flow.

5.1.4 Hydraulic free play at centre that is input rotation (in degrees) required to raise the inlet pressure by one bar above the neutral pressure shall be carried out with the gear at centre and supply at rated pressure and the test flow.

5.1.5 *Lost Motion Test (Backlash)*

With the gear at the centre of travel, rotate the input shaft through -30° to $+30^\circ$ with the inlet and outlet ports vented to atmosphere. The output shaft shall follow the input shaft movement without backlash. Further there shall be no axial (in and out) movement of the worm/input shaft.

5.1.6 *Leakage*

When steering gear is equipped with a relief valve, replace valve with a suitable plug before leakage testing.

5.1.6.1 *External Leakage*

No external leakage is permissible with gear statically pressurized as detailed below:

a) *Low pressure leakage* — with outlet port locked and gear submerged in immersion fluid, pressurize with test gas at 0·3 to 0·7 kg/cm^2 for 20 seconds minimum. Increase the pressure to 7 to 10 kg/cm^2 for 20 seconds minimum. Visually check for leaks during this procedure. Repeat this cycle 2 or 3 times and if the gear complies with the requirements then only it shall be subjected to high pressure test.

b) *High pressure leakage* — as specified in **5.1.6.2**, pressurize gear to rated pressure with hydraulic fluid and maintain pressure for 10 seconds minimum and visually examine for leaks.

5.1.6.2 *Internal leakage*

With gear at centre of travel, pitman arm located in centre and with the input shaft torque value as specified in **3.2.3**, with supply at rated pressure, flow across the valve shall not exceed manufacturer's specification. Internal leakage to be checked 3 to 10 seconds after application of torque to input shaft. Perform the test for both directions of rotation of input shaft.

5.1.7 *Unloading Valve Test* (*when Provided*)

With poppet adjusting screw positioned to ensure that the poppets are tripped and with the rack positioned at bottom against the internal stops and input shaft torque value conforming to the value specified in **3.2.3**, the maximum differential pressure between inlet and outlet ports shall be half the rated pressure at test flow. Perform the test at both ends of travel.

5.1.8 *Neutral Pressure Drop*

With the input shaft unrestrained, the differential pressure between inlet and outlet ports shall not exceed the value recommended by the manufacturer at that test flow.

5.1.9 *Reversibility Test*

With the input shaft unrestrained, the gear shall reverse from each extreme of recommended travel to centre within 5 seconds after applying a torque specified by the manufacturer to the output shaft with the test flow supplied to the gear.

5.1.10 *Performance Rating*

5.1.10.1 *Hydromechanical rating*

With test flow supplied to the gear and rated torque applied to the output shaft rotate the input shaft at a rate not exceeding 60 rev/min. Differential pressure between inlet and outlet ports shall not exceed rated pressure and input torque value shall not exceed the value recommended by the manufacturer throughout gear travel (excluding zone of stroke limiter operation).

5.1.10.2 *Mechanical efficiency*

With the gear filled with fluid and inlet and outlet ports vented to atmosphere, rotate the input shaft (end to end) at a uniform speed of 20 rev/min and measure the average input torque required for an output torque of 1/3 of rated torque. The torque efficiency shall be calculated as specified in **3.1.3** of IS 13476 : 1992 and the value obtained shall be greater than 60 percent.

5.2 Static Strength Test — (*see* Fig. 2).

With the gear assembly mounted on a suitable fixture, lock the output shaft at centre of travel, apply a torque corresponding to maximum hand force permissible at the steering wheel to the input shaft, in both directions. Gear assembly is to be filled with lubricant and inlet and outlet ports vented to atmosphere.

5.2.1 *Performance Criteria*

After the test, the gear shall be operable.

NOTES

1 An operable gear assembly is defined as an assembly, which is rotatable in both directions of travel at full rated load with power on.

2 Maximum hand force permissible at steering wheel shall be as specified in IS 11948 : 1986.

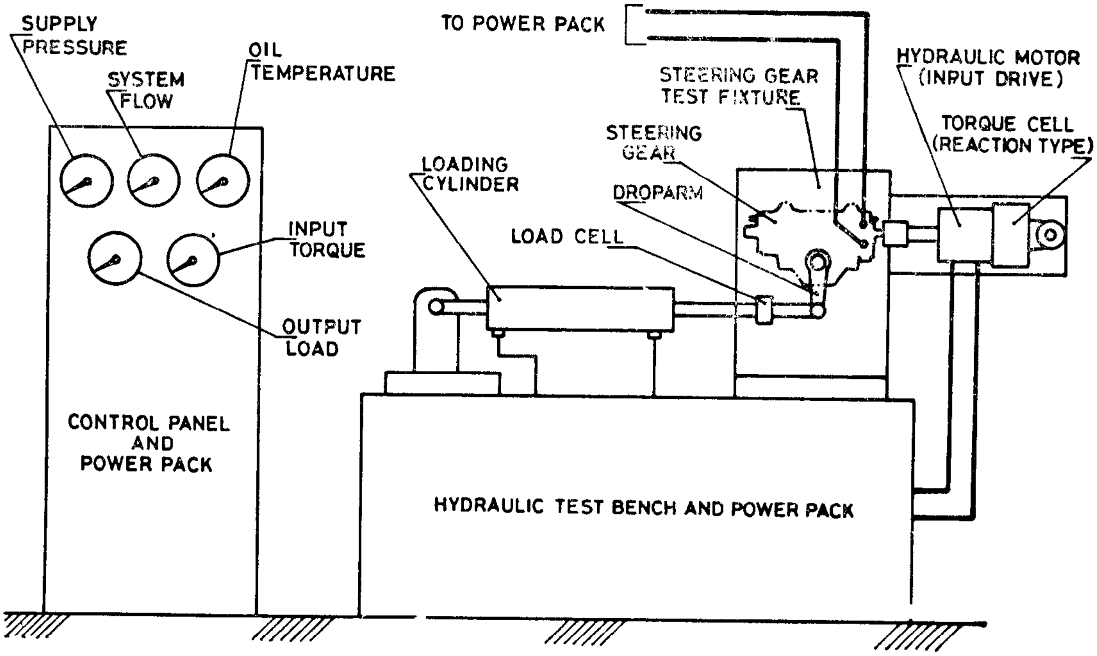
SUPPLY PRESSURE
SYSTEM FLOW
OIL TEMPERATURE
INPUT TORQUE
OUTPUT LOAD
CONTROL PANEL AND POWER PACK
TO POWER PACK
LOADING CYLINDER
LOAD CELL
STEERING GEAR TEST FIXTURE
STEERING GEAR
DROPARM
HYDRAULIC MOTOR (INPUT DRIVE)
TORQUE CELL (REACTION TYPE)
HYDRAULIC TEST BENCH AND POWER PACK

FIG. 2 TYPICAL HYDRAULIC TEST BENCH FOR STATIC AND DYNAMIC TESTS FOR POWER STEERING GEARS

5.3 Dynamic Tests — (*see* Fig. 2).

5.3.1 *Wear Test (Power On)*

With the gear assembly mounted on a suitable fixture, rotate the input shaft to cause the output shaft to travel through 5 degrees less than the maximum angle of travel either side of centre as specified by manufacturer. Adjust the load on a drop arm so that supply pressure does not exceed the rated pressure. With test flow and fluid temperature as in **3.2.2**, rotate the input shaft at 60 rev/min (*Max*).

5.3.1.1 *Performance criteria*

a) The gear shall complete 30 000 test cycles and still be operable. One cycle is starting from centre, going to one extreme on to the other extreme and back to centre.

b) During test, external leakage and loosening of fasteners shall not be permitted.

c) At the end of test, internal leakage carried out as specified in **5.1.6.2** shall not exceed double the value before test.

d) At the end of test there shall not be any cracks or material detachments. However normal wear marks on the individual components shall not be considered as failure.

5.3.2 *Wear Test (Power Off)*

With a new gear assembly (new sample) mounted on a suitable fixture, the input shaft shall rotate to cause the output shaft to travel through 5 degrees less than the maximum angle of travel either side of the centre. With the assembly adequately lubricated, apply sufficient load on drop arm to reach an output torque equal to one-third of rated torque and cycle the gear.

5.3.2.1 *Performance criteria*

At the end of 1 000 test cycles, the gear shall retain measurable pre-load as evidenced by friction torque values (*see* **5.1.2**) at the end of test and that after releasing the pre-load adjusters.

NOTE — Rated torque for the gear under test shall be specified by the manufacturer.

5.3.3 *Fatigue Test (Power On)*

a) With the gear assembly at the centre of travel, lock the input shaft and apply alternating load on drop arm.

b) Gear shall be supplied with test flow at rated pressure and temperature as in **3.2.2**.

c) Adjust load on the drop arm, so that the supply pressure does not exceed the rated pressure.

5.3.3.1 *Performance criteria*

a) The gear shall complete 50 000 test cycles and still be operable.

b) During test, external leakage and loosening of fasteners are not permissible.

c) At the end of test, internal leakage carried out in the manner specified in **5.1.6.2** shall not exceed double the value before test.

d) At the end of test, there shall not be any cracks or material detachments. However normal wear marks on the individual components shall not be considered as failure.

5.3.4 *Impact Test (Power On)*

With the gear assembly mounted on a suitable fixture, lock the input shaft with the gear at centre of travel. Supply test flow at rated pressure as specified in **3.2.2**.

Apply load to output shaft through a drop arm at a nominal rise rate of 2 500 to 3 000 m-kg/sec. Apply load to a level of two times the maximum operating torque and maintain for 0·7 second.

NOTE — Maximum operating torque for a particular application shall be specified by the user.

5.3.4.1 Performance Criteria

a) This test shall consist of two impact loads as detailed above in each direction. The gear shall be operable at the end of test.

b) At the end of test, there shall not be any cracks or material detachments. Individual components may show indentation/deformations which shall not be considered as failure.

Alternatively, instead of the dynamic tests specified in **5.3** the power steering gear may be tested for endurance which combines the effects of all the above tests as detailed below.

5.3.5 *Endurance Test*

The gear assembly mounted on a suitable test fixture shall be supplied with test flow at rated pressure and temperature as specified in **3.2.2**.

Rotate the input shaft at 60 rev/min maximum and load the drop arm as below:

Sl No.	*Input Rotation*	*Resisting Torque at Output Shaft*	*No. of Test Cycles*	*Remarks*
1.	±180	40 percent of rated torque	30 000	Normal steering torque
2.	Maximum usable range	85 percent of rated torque	7 500	Dry parking torque
3.	±180	40 percent of rated torque	55 000	Normal steering torque
4.	Maximum usable range	85 percent of rated torque	7 500	Dry parking torque
5.	Maximum usable range	200 percent of rated torque (only 100 percent of rated torque shall be supported by hydraulic assistance remaining 100 percent shall be supported mechanically by the input drive to simulate manual loading)	10	Rut and Kerb jacking/ impact torque

5.3.5.1 *Performance criteria*

a) At the end of test, the gear shall be operable.

b) During test, external leakage shall not be permitted.

c) After the test internal leakage carried out as specified in **4.1.6.2** shall not exceed 2·5 times, the value before test.

d) Individual components may exhibit normal wear marks. At the end of test there shall not be any cracks or material detachments visible on the gear assembly. However normal wear marks on the individual components shall not be considered as failure.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Automotive Suspension and Steering Systems Sectional Committee, TED 5

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Shri M.V.S.D. Prasada Rao

Joint Director (Transport Engg), BIS

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Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
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Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VIII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 84 99, 37 85 61 37 86 26, 37 86 62
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